

III.—THE UNDEVELOPED COAL FIELDS OF NOVA SCOTIA.—By
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(Read 10th February, 1896.)

The question of the possible discovery of new coal fields in this province is interesting from both a scientific and a practical standpoint. At present the growth of our coal industry is measured by the home demand. The Maritime Provinces take an amount which is steadily, if not rapidly, increasing, as new manufactures are started and firewood becomes scarcer. The Newfoundland demand will not, so far as can be seen, increase rapidly, and moreover, competition is threatened by the island deposits. The trade of the St. Lawrence appears at present practically secured to Nova Scotia, and will grow proportionately to the development of that important section of the Dominion. Ottawa and Montreal appear to mark the western limit of the trade. The inauguration of any policy by which our coals can be pushed further westward against the competition of United States coals rests with the deepening of the canals and the assistance of the Federal Government.

If an outlet be obtained in the New England States the development would grow apace.

We have the subject presented from a practical standpoint. What are the possible reserves beyond those deposits now being worked? While the present mines can be extended in the worked and adjoining seams to meet a demand many times larger than the present, the enquiry is still pertinent. If there is an assurance that outside of the present development there are other tracts that may be drawn upon when needed, the confidence and credit of the province are increased. The assurance of unlimited supplies of fuel, even though we sigh now for larger markets, advertises us abroad and encourages capital to examine our resources of other minerals, and generally to consider more favorably our aspirations for investments of capital.

The *Journal News* has recently published a summary of explorations carried on last year by the Cumberland Railway & Coal Company in the measures underlying the seams at present worked by them. It has always been known that there were underlying seams, but details as to their size were not available. The company has now shown that there are a number of workable seams of good quality available at any time, as shown by the following section in descending order from West slope seam :

	Feet.	Inches.
Seam	3	4
Strata	—	—
Seam	4	3
Strata	—	—
Seam	5	6
Strata	—	—
Seam	2	8
Strata	—	—
Seam	1	6
Strata	—	—
Seam	7	6
Strata	—	—
Seam	2	0
Strata	—	—
Seam	4	8
Strata	—	—
Seam	5	0
Strata	—	—
Seam	7	0
Strata	—	—
Seam	2	4
Strata	—	—
Seam	—	—

This is a case exactly in the line of this argument. The value of the property of this company was before a defined item ; they had large tracts of coal opened by their slopes, ensuring, as far as the coal miner could judge, many years of work. The dis-

covery, however, of these seams, even if they are not likely to be worked for some years, has been a distinct advertisement for that district, and encourages the confidence the local business men and the province feel in the permanency and future extension of the trade of Cumberland County.

I do not pretend this evening to have the wand of Fortunatus, and to disclose to you vast fields of unworked coal, but briefly to refer to districts which may be found upon examination to hold coal of economic value.

The student of geology is most appreciated when he can show the public some material advantage accruing from his investigation, and his predictions are often correct and useful even when they are unpalatable.

I need not refer here to those sections in the province in which coal is now being regularly worked, but proceed to notice briefly the geological conditions which, so far as our experience goes, govern the presence of coal in Nova Scotia.

The term carboniferous is applied by geologists to a group of palaeozoic strata, which, while distinguished by holding the best deposits of coal, are also possessed of certain other notable characteristics.

Sir William Dawson stands out as the special delineator of the divisions of this system in the Maritime Provinces. He divided it into:—

- Upper Coal Measures,
- Productive Coal Measures,
- Millstone Grit,
- Limestone Series,
- Lower or Basal Measure.

And these sub-divisions have been in a general way followed by other geologists.

In this province the limestone series has not presented any workable deposits of coal. It is, as you know, distinguished as an important source of limestone for fluxes, etc., as well as furnishing enormous deposits of gypsum. It is also valued by the

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miner as containing ores of iron, manganese, barytes, as well as scattered indications of copper and lead ores. In this connection, however, it need not be referred to in greater detail. The same may be said of the Lower or Basal series. This is composed largely of conglomerates and coarse Grits which often rest on Silurian or Laurentian strata, in some cases holding contact deposits of iron ore or manganese. At several points, however, in the province, the conditions of deposition permitted the accumulation of more finely comminuted strata, and we have beds of shales, often bituminous or carbonaceous. It is noticed at a few points that the accumulation of carbon matter has been large enough to form impure "coal" beds. Prospectors have spent much time and money with unsatisfactory results in these strata, which often surpass the shales of the productive measures in their various carbon contents. In a few cases these coaly beds have been hardened by metamorphic action into graphitic slates or semi-anthracitic beds.

As far as I am aware the Upper Coal measures contain only a few thin but remarkably persistent seams running from Merigomish to River John. This set of strata appears to pass by no fixed line into the lower and preceding productive measures. These again are divided by no arbitrary boundary from the Millstone Grit. Coal seams are not infrequent in the Millstone Grit in Nova Scotia as in other countries. We are therefore, in the study of this subject, concerned in the presence of coal in the Productive and the Millstone Grit measures, and they may be considered together.

In the Sydney coal field the boundary laid down between these systems is based principally on the cessation of thick and abundant coal beds and the presence of seams smaller and not so abundant, as well as on the appearance of strata coarser in texture. Mr. Fletcher of the Geological Survey, however, in continuing his survey of Cape Breton, found that in many places nature did not present coal seams and differing strata conveniently for this purpose, and has grouped the two together. The question need not be gone into here as to the true horizon of some of our coal

deposits, as we are now practically concerned about the size, etc., of coal beds, not about their scientific age.

Leaving the consideration of the productive measures of the Sydney coal field out of the question, and adopting the boundary there laid down by the Geological Survey between the two sets of measures, it may be taken as a fact that in the Millstone Grit in that district there do exist workable seams of coal of which I may mention the Mullins, Gardner, Long Beach and Tracey seams. It is plain, therefore, that even if exception may be raised to the productive age of the rocks holding coal seams elsewhere, we are starting with the important premises that the Millstone Grit does hold valuable coal seams in the Sydney district, and that in other districts explorations may show deposits of equal value. The following condensed sections will show what is so far known of the coal contents of this horizon in the Sydney district:—

In Cape Breton County there extends from the rear of Lingen Bay and Glace Bay to Mira, and thence up the river of that name and its branch, the Salmon River, as far as Loch Lomond on the county line, a large area of Millstone Grit. Seams of coal are known throughout this district. Classing the Mullins, Gardner and Tracey seams in this horizon the fact is established that it presents seams of workable size lying, geologically speaking, thousands of feet below the seams classed as the lowest of the true or productive measures, as shown by the following condensed section:—

In the section showing from the south head of Cow Bay to the head of Mira Bay there are, in about 1,900 feet of strata, eleven seams of coal, the thickest, the Tracey, being 4 feet. Four of them have a workable thickness.

In the centre of the district, assuming with the Geological Survey that the summit of the Millstone Grit begins a short distance above the Lorway or Gardner Seam, we have first that seam 5 feet 9 inches thick, then in about 700 feet of measures there are six coal seams varying in thickness up to two feet.

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In the section underlying the productive measures at Low Point, at a vertical distance of 600 feet below the top of the Millstone Grit, is the Mullins seam, 6 feet 4 inches thick. Several other smaller seams unknown in this section of which I have no details.

On the North Sydney side of the harbor the Geological Survey give only one seam about 580 feet below the top of the Millstone Grit, the Matheson seam, 2 feet thick. It is claimed by those who have since prospected this district that there are several other seams up to 5 feet in thickness.

On the Big Bras d'Or the sections of the Millstone Grit have hitherto shown only traces of coal.

For a few years past attempts have been made to trace the Mullins seam southwardly into the extensive district lying between Sydney and Glace Bay, and to prove the Tracey seam northwardly into the same district. These efforts have not yet proved successful. There are a number of seams known in this area, as shown in the section, none, however, large enough to compete with those at present worked, although they will be drawn upon in the future when the larger seams become exhausted, and they contain in the aggregate many millions of tons of coal.

On the Morrison road explorations have been carried on by Mr. Harold and other Sydney parties. They claim to have bored through a number of workable seams. The details of this exploration, not yet completed, will be received with interest, as if their claims as to the thickness of the seams are supported by a good quality of coal a most important addition will be made to the coal resources of the district.

An interesting portion of this coal field was described by me in a paper read before you last winter, as the results of some of the prospecting for the Tracey seam. Attention was drawn to the curious fact that the fossils of the Cossitt coal field were identical with many characteristics of the true coal measures, although the locality lies in the heart of a wide expanse of Millstone Grit.

Southerly of this lies the Mira district; here there are a few known outcrops of small seams, but little tested except at some natural exposures. The country is swampy with numerous lakes and moss grown, and the natural exposures are principally of the harder ridges of sandstone or grit. In the Salmon River district there are three well marked seams of coal from 12 to 36 inches in thickness, lying in the valley between the East Bay and Mira felsites, etc.

The work showed the existence of a long narrow trough holding the outcrops of several seams under two feet in thickness.

The first of these on the Gaspereau River road is stated to be eighteen inches thick, to burn well and to yield little ash. A second outcrop similar in character occurs between the Glengarry and Ardoise roads on the shore of a small lake. The third and most important exposure is on the Salmon River, two miles south of the Morrison road, where two eighteen inch seams are met divided by a band of fire-clay. The coal burns readily, but from the following analysis contains an unprofitable amount of ash:—

Moisture	1.53
Volatile Combustible Matter.....	20.16
Fixed Carbon.....	47.49
Ash	30.82

It was stated some time ago that explorations had shown larger and more promising outcrops in this district. The prospectors have taken out a number of leases and as they are willing to pay the annual rental on them it must be presumed that they are satisfied with their prospects.

In the district lying to the westward of the General Mining Association's lease at Sydney Mines, and extending from Sydney Harbor to the Big Bras d'Or, there are a number of outcrops of seams. Local authorities, as already stated, claim to have identified them with the lower seams on the Victoria Mines shore of the harbor, and that they are in some instances increased in size.

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As yet, however, this district has not as a whole been systematically tested, and indications are not wanting that the conditions, favorable to the formation of coal beds in the Millstone Grit, decreased with proximity to the syenitic rocks of St. Ann's.

The Millstone Grit of the Sydney district appears to attain its maximum thickness in the Mira Bay section, and according to Messrs. Fletcher and Robb, it decreases until at its northern extremity in the Cape Dauphin district it has diminished from over 5000 feet to less than 2000 feet. Being derived from the detritus of the underlying strata it is reasonably noticed that as it approaches the older and harder pre-carboniferous rocks it becomes scantier and coarser. This change necessarily diminishing the opportunity for the presence of those conditions permitting the accumulation of carbonaceous matter.

Passing to Richmond County there is found a long stretch of the debatable Productive Millstone Grit measures running from near St. Peter's across the lower part of the Inhabitants River nearly to Hawkesbury.

Coal seams of economic value are known at Coal Brook, Little River and Carabacou Cove. At the first named place explorations have shown a three feet, a four feet, and several smaller seams of coal. The quality is stated to be good as far as the crop workings were extended. At Carabacou Cove, or, as it is also called Sea Coal Bay, quite extensive workings were carried on about thirty years ago in a seam eleven feet eight inches thick, holding some layers of shale. Reports made to the Government of Nova Scotia state that there are in this connection at least seven other seams ranging in thickness from three feet upwards, beside a number of smaller ones. The Big Seam was reported by Sir William Dawson to carry an abnormally large amount of ash, as shown by the following analysis :—

Volatile Matter.....	25.2
Fixed Carbon.	44.7
Ash	30.1
	—
	100.0

Owing to the want of demand for coal and to the heavy surface cover accompanied by the almost vertical position of the seams, little progress has been made in tracing the seams inland towards Hawkesbury. It is probable that they are sharply folded at no great distance from the shore, and their nearest outcrop at Little River represents their re-appearance on a parallel folding.

At Little River the measures are steeply inclined and present the following section ascertained by the Eastern Development Company some years ago:—

	Feet.	Inches.
Coal	3	0
Strata	154	0
Coal	4	0
Strata	60	0
Coal	3	0
Strata	45	0
Coal	5	0

The upper beds were opened and a few hundred tons extracted. The coal is compact and apparently of good quality. The upper part of the section appears to agree with that of Sea Coal Bay.

The following analysis given by Sir William Dawson in a report made by him many years ago, will show that the large percentage of ash forms the principal drawback to the fuel:—

Volatile Matter	30.25
Fixed Carbon	56.40
Ash	13.35
	100.00

I am informed that the workings of the Eastern Development Company a few years ago showed a decided improvement in the quality of the coal away from the outcrop. Attempts made to follow these seams have not proved successful, probably because they are here as at Sea Coal Bay folded in sharp curves, and the surface is level and deeply covered with detritus. The construction of a railway from Hawkesbury to St. Peter's and Louisburg, recently subsidised by the Provincial Government, across this

coal field will in this improve favorably situation.

During the development of the coal field, it threw open a number of desultory seams. It is regretted that they were not available information statement.

This district appears to be devoid of beds not yet discovered.

At Glendale there is a small seam in extent, showing smaller seams and overgrown in many places with detritus. For tracing the coal field, it is necessary to make deep borings.

At Mabou, separated by a narrow neck, connected. Given by Mr. M. follows:—

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coal field will undoubtedly lead to a fresh interest being taken in this important but hitherto almost unknown coal field, so favorably situated for marine shipments all the year round.

During the early days when the almost complete abandonment of the exclusive rights of the General Mining Association threw open the provincial coal areas to the public, a great deal of desultory prospecting was done in this district. It is to be regretted that the results of this work have been lost, if indeed they were ever recorded. Mr. Fletcher, after compiling all available information, has been able to present only a comparative statement of its structure.

This district differs from that already described in that there appears to be a relationship between the gypsum and the coal beds not yet clearly explained.

At Glendale, on the upper waters of the River Inhabitants, there is a small fairly well defined coal field, a few square miles in extent, showing, from recent explorations, a three feet and a smaller seam. Great part of the Inhabitants district is swampy and overgrown with spruce and alder thickets. The strata in many places are soft, worn down, and covered with heavy local detritus. For these reasons little progress has been made in tracing the structure, and beyond the known outcrops it will be necessary to resort to the expensive process of systematic and deep borings. So far, however, it may be fairly assumed of this coal field that there must undoubtedly be a large amount of coal in it.

At Mabou there are two small patches of coal measures, separated by half a mile of lower strata, evidently at one time connected. They contain in the more southerly basin four seams given by Mr. R. Brown in his "Coal Fields of Cape Breton," as follows :—

	Feet.	Inches.
First Seam.....	5	0
Second Seam.....	7	0
Third ".....	13	0
Fourth ".....	4	0

included in about 550 feet.

As these strata have an inland range of only a few hundred yards and dip under the sea, their value is by no means commensurate with the richness of the section. It is important, however, to note that such favorable conditions existed on this side of the island for the accumulation of coal seams.

The Port Hood district may next be referred to. Here openings have been made on an excellent seam, which, outcropping on the shore, dips under Port Hood Harbor. In the rear of this seam there is an area of about ten square miles which merits examination. Coal seams of small size are reported about a mile from the shore at Port Hood, and indications of coal for nearly two miles further east.

The following section shows the relative positions of the seams as given by Mr. Brown:—

	Feet.	Inches.
Coal at tide water.....	6	0
Strata.....	360	0
Feet. Inches.		
Coal	1	0
Coal Slate..	0	9
Coal	4	3
Strata containing several thin seams..	1500	0

Should coal seams be found in the as yet unexplored district back from the shore they will presumably extend not only under the land area but also conjointly with the known seams under the harbor.

The islands forming Port Hood Harbor are partly underlaid by coal measures. It has been assumed that a shaft sunk on them would open up a large coal field. While the measures are the same on the islands as on the mainland, the faults on them bringing up the limestone and gypsum would render the assumption of absolute continuity a matter of discussion. The question of their value to the coal miner could be settled only by boring.

At Broad Cove work has been done to show that in the land area there are a number of valuable coal seams, which will also be available under the water. The area of this coal field appears

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to be limited on the south by the syenite of Cape Mabou on which it rests without the intervention of any of the lower groups of the carboniferous. Its inland extension at other points appears to be limited distinctly by the belt of limestone and gypsum which sweeps from the shore north of the mouth of the Broad Cove Brook nearly to the Mabou Hills. Here there is an interval of metamorphic lower carboniferous rock probably valueless to the coal miner. The coal field on land is about six miles long and about two miles across at its greatest width.

The sections of the seams as given me during the past few years do not agree with those hitherto published, or with one measured by me some years ago.

Mr. W. H. Ross, who has been engaged by the Broad Cove Coal Company in opening the seams and in making a shipping harbor at McIsaac's Pond, an inlet on the centre of this coal field, has kindly agreed to give the Institute a full description of this district. I will therefore not attempt to correlate the sections, but for the purpose of rounding out these notes will give the following sections from Mr. Robb's report to the Canadian Geological Survey:— In descending order,

	Feet.	Inches.
Seam No. 1.....	3	0
" 2.....	5	0
" 3.....	7	0
" 4.....	4	6
" 5.....	3	0
" 6.....	3	9

An idea of the importance of the western shore of Cape Breton as a future coal producer may be formed from Mr. Robb's estimate that these seams contain on land not less than 26,000,000 tons in the land area and 34,000,000 in the sea area to a distance of only half a mile from the shore. As there is also, in addition to the seams named, a fourteen feet seam of coal, these estimates should be largely exceeded, and the sea area of available coal held by parties other than those named by him also hold large amounts of coal.

Continuing to the north, the Margaree, or as it is more commonly known the "Chimney Corner" district, is next met. Here the shore from Marsh Point to Margaree Harbor is occupied by coal measures, indicated as being made up of Productive and Mill-stone Grit rocks. The length of this field on land is about twelve miles and its width about $2\frac{1}{2}$ miles. At Chimney Corner workable seams of excellent quality have been opened and mined to a small extent. At the mine these beds are close to the water and could presumably be followed under it. Little or no mining and exploratory work has been done at Chimney Corner for a number of years. The following section is from a report by Professor Hind:—

	Feet.	Inches.
Thin Seam.....	1	6
Strata	300	0
Coal	3	0
Strata	88	0
Coal	5	0
Strata	200	0
Coal	3	6

The seams have been traced to the south about four miles, and are stated to be larger and of equally good quality. The section of country lying back of these seams has yet, so far as I am aware, never been examined for coal. It is stated that a few outcrops of thin seams and of a three feet seam have been found about two miles from the shore. The reasons for this indifference as to the possible coal values of this district are not far to seek. The isolation of the locality and the absence of shipping facilities are evident. If, however, at any time shipments were decided on, no difficulty would be experienced in making a harbor at Chimney Corner, or in dredging the entrance to Margaree Harbor. A lagoon harbor is now being made at McIsaac's Pond, at Broad Cove, and the establishment of the same style of harbor at Margaree would be attended with less difficulty as the volume of the Margaree River is sufficient to secure a considerable scouring action.

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It may be mentioned that Seat Wolf Island lying a short distance off the shore at Chimney Corner is composed of measures the same as those on the mainland, and this fact contributes to the permanence of any subaqueous extension of the coal seams. From Margaree to the northern end of Cheticamp Island there is a narrow fringe of coal measures. I am not in possession of any information as to the indications of the presence of coal in the Cheticamp district.

No point in the interior of the island presents coal measures, and it has been carefully examined by Mr. Fletcher. The two systems occurring there are the felsites, syenites, limestones, etc., of the Laurentian and the basal conglomerates, limestones, gypsums and associated beds of the lower part of the carboniferous.

Reports of discoveries of coal are not infrequently made from localities outside of those I have referred to, but so far as our geological information goes they are not likely to prove of value, and the test of exploration has invariably sustained this view. At St. Lawrence Bay the coal seam is a black bituminous shale holding patches of coaly matter and associated with limestone and gypsum.

At Hunter's Mountain and Ingonish irregular and impure layers of coaly matter occur in the Lower Carboniferous. On the Mabou River, East Bay, and a number of other places work has been done on carbonaceous shales, which often carry sufficient carbon to burn and give heat enough to raise steam and to be used for domestic purposes. The percentage of ash, however, is a fatal barrier to their competition with imported Anthracite coal. These beds may present greater value as sources for the manufacture of oils, etc.

Beds of graphitic shale or slate are frequently taken to indicate the vicinity of coal, or are tested with faith in the mining axiom that every mineral becomes richer the deeper it goes.

Other discoveries of coal resolve themselves into beds of black fire clay or shale carrying streaks of coaly matter, or into limited masses of coal due to some small accumulation of plant remains, and consolidated into a more or less bituminous coal, often holding a high percentage of ash.

The following analyses will show the character of these "coals":—

	1	11
Volatile Combustible Matter.....	17.50	36.72
Fixed Carbon.....	29.04	46.64
Ash.....	53.16	16.64

At present, of course, the interest of the prospector in the unexplored portions of the coal fields of Cape Breton lies in the hope of discovering seams which will compete in size with those now being worked. All things being considered a seam of coal about six feet thick can be worked as economically as a larger one and more cheaply than a smaller one. As this paper is written with as much reference to the future as to the present status of the coal industry, it is fair to remember that coal seams with a much less thickness than six feet often acquire more than a local value. From the recently published report of the investigation of the British Iron Trade Association into the conditions affecting the iron industries of Belgium and Germany, a reference can be given directly bearing on this point. The official reports of the Belgian Government show that the average depth of the Belgian coal pits was 1,400 feet, and the average thickness of the worked seam was 2.08 feet.

In Germany, the same report states, the official returns show the average thickness of the worked seams to be 3.28 feet. It is plain from these figures that in these countries a large number of very thin seams must be worked to give so low an average thickness. Connected with this point the figures given by the report as to the cost of the coal at the pit head in these countries is interesting. The cost is in Belgium about \$1.75, in Germany about \$1.60, and in England about \$1.45 per ton.

The discovery therefore in the areas referred to of seams of coal, even though they be smaller than those at present worked, is of value, as locating future reserves of fuel. The work so far done has proved that very large areas in these districts present seams at present available to the coal miner so far as their size

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and quality is concerned ; and there appears to be good ground for believing that these seams may be found to extend over considerably larger areas than at present proved, that other seams equally good may be discovered, and that numerous smaller seams which will prove valuable in the future are present, and that others will probably be found.

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